Archaeological
Institute
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THE THEORY OF GOTHIC ARCHITECTURE AND THE EFFECT OF SHELLFIRE AT RHEIMS AND SOISSONS

I

The Problems in the Theory of Gothic

To the student who makes a careful review of the present writers on Gothic, it is evident that there is a considerable divergence of opinion among them. This divergence is not only in regard to its origin and its historical development, about which there must always be differing theories, nor in the limitation of the term to a greater or less number of buildings and provinces, but it is a variance in the theory of the determining principles themselves and of the main features of the buildings. Apparently the theory of Gothic is still undergoing modifications, in spite of the serious works of several authors who have endeavored to present a comprehensive and final view of it. To collect these views in some orderly arrangement, with an attempt to give them the relative importance that the opinion of the majority seems to agree upon, may well be our first step in establishing a working basis for our observations and criticism. In so doing we shall bring out the various points in dispute and see clearly for what we must search in the ruined monuments.

At the outset, a distinction should be made, which is often overlooked, between the determining principles and the forms or architectural features of the buildings. To illustrate, the concentration of supports is a principle, a pier is an architectural form; or, to take a case more frequently confused, the transmission of thrust is a principle, but the flying arch is not, being merely a device of construction or "flying buttress." In this connection, too, it may be noted that the principles are few, but the forms through which they were expressed are many.

I. Of all the principles involved in the conception and execution of a typically Gothic work, the one most generally emphasized

is that of logic in construction. According to Viollet-le-Duc, the great early exponent of Gothic, this was its chief underlying idea, almost to the exclusion of others. For him the historical development of perfected Gothic was dictated by logic throughout and it was in obedience to close reasoning along constructional lines that each great cathedral was designed. This view has been developed to an even greater extent by the American writers, who have largely formed the theory as we know it today. Professor Moore, Mr. A. Kingsley Porter, and Professor Frothingham in their very extensive studies of the subject have applied this idea to nearly all parts of the building and have insisted on it with the greatest positiveness. Even the latest English writers who have treated French Gothic, Jackson and Simpson, have taken the same stand.

On the other hand, there seems to be somewhat of a reaction against too much emphasis on logic as the governing factor. The French writers, who, after all should have some hearing on such a subject, and who are, by race at least, inclined to be logical themselves, while assigning to logic the principal rôle, yet take pains to show that the Gothic cathedral is in some respects not logical in fact, whether it was so in intent or not. Thus, one of them, Brutails,[1] insists that the originator of this theory, Viollet-le-Duc himself, was very prone to *a priori* reasoning, with a reckless treatment of facts in support of his hypothesis, and that "logic" with him was almost an obsession in his later years. Viollet-le-Duc has also been found to be mistaken in regard to the communal or civic character of the motive that produced the cathedrals. Mr. Porter has shown with great thoroughness that they were entirely ecclesiastical in their origin. M. Guadet, an architect as well as a profound student of all architecture, considers the whole system of abutment of the vault thrusts as merely one of two possible solutions, the other being the tie rod used in Italian Gothic.[2] He raises the point whether the French system, the flying arch and buttress, being more uncertain and less economical, is indeed as logical.

M. Enlart, one of the greatest French authorities on Gothic, in his study on the cathedral of Rheims[3] considers that here rig-

[1] Brutails, *L'Archéologie du Moyen Âge*, p. 181.

[2] Guadet, *Elements et Théorie de l'Architecture*, II, p. 307.

[3] Enlart, *La Cathedrale de Reims* (Special No. of *L'Art et Les Artistes*, 1915), p. 23.

orous logic was secondary to beauty of form, notably in the flying arches, of which the upper tier is without use, even as a conductor for rainwater.

Among the architects, as contrasted to the archaeologists, Mr. R. A. Cram, one of the greatest American designers as well as students of Gothic, asserts[1] that the informing principle in the twelfth century was a love of beauty, whereas logic, later obtaining the upper hand as in Amiens, produced only inferior buildings. Professor Hamlin, who in his History, first published in 1897, considered[2] that principles "of structural stability and propriety controlled the development throughout," in his latest analysis[3] maintains very strongly his belief that the part of logic has been over-emphasized and that in fact it was secondary to the esthetic considerations, especially after the formative stages of the style had been passed.

Here, then, is a difference of emphasis amounting to a real divergence of opinion in the most fundamental principle, at the very outset of the whole definition of Gothic, a difference inviting us to possible elucidation and discussion.

II. Another underlying principle that is given an almost equal importance and that, if true, marks off the style absolutely from all others except the immediately preceding stages of later Romanesque, is what has been called its *dynamic* quality. In the phrase of one of the latest exponents, it was the first time in architectural history, that a living force was set in motion to overcome and neutralize the action of another living force, as contrasted with an architecture based on inert resistance. "The laws of beauty were subordinated to the laws of scientific life . . . and so a Gothic building became a living organism."[4] How far this conception has been carried may be seen from another well-known author, an Englishman, but a great lover of French Gothic and a beautiful draftsman of many of its buildings, who speaks[5] of "the mighty unseen forces engaged in fierce combat."

This quality is usually insisted upon in the definitions of Gothic, and no wonder. It is striking to a degree, novel to the general reader, and fascinating in its appeal to the imagination. And

[1] R. A. Cram, *Heart of Europe*, pp. 110–111.
[2] Hamlin, *History of Architecture*, 1897, p. 193.
[3] Hamlin, *Arch. Rec.* XL, 1916, pp. 110–112.
[4] Sturgis and Frothingham, *History of Architecture*, III, p. xxix.
[5] T. C. Jackson, *Reason in Architecture*, pp. 126–127.

yet when one looks for the concrete applications of this principle, so striking to the layman, but suspicious to the architect, he finds it limited principally to the flying arch and buttress. There is a feeling in the reader's mind that there is also somehow a balance of one groin vault against another, of the chevet vaults against the last vault of the nave, or of one aisle arch against another; but there is a great lack of definiteness. Even in the case of the flying arch itself, there is considerable confusion, some authors giving the impression that it exerts a thrust to counter-balance the thrust of the vault inside the wall. Some like Hamlin and Guadet state that it only *transmits* the vault thrust to the buttress, acting as a strut, while others like Moore and Jackson call it a prop, but consider that in this feature "the equilibrium by opposing thrusts is completely developed."[1]

Now, here is a perfectly definite issue. Does the flying arch exert a push against the vault or is it a pure strut, that is a slanting post which receives the outward push of the vault at one end and transmits it to the buttress at the other? In the latter case, there is no balance of thrusts but merely a thrust on a column, and the principle of the opposing thrusts, deprived of its leading application, must be circumscribed. Here again we may well look to find some light on the true state of affairs from the ruined buildings themselves.

In the other applications of this principle, the issue is less definite. Hamlin in his latest writing, however, says[2] "the only balanced thrusts are really those of adjacent pier arches and wall arches and transverse vaults, which do thus balance each other." The last statement might seem to be possible of immediate acceptance, but just how far all this actually corresponds to the construction may also be developed by a study of the parts that have stood in the ruined churches where the adjoining parts have been destroyed.

III. The next principle in importance is that of the highly organized framework, or skeleton, consisting primarily of ribs, piers, flying arches, and buttresses. This is excellently stated by Mr. Moore in his summary of Viollet-le-Duc's theory, in which he describes it[3] as a system whose distinctive characteristic is "that

[1] C. H. Moore, *Development and Character of Gothic Architecture*, p. 112; see also p. 8 and p. 20, § 5.

[2] *Arch. Rec.* XL, 1916, p. 109.

[3] Moore, p. 8.

the whole scheme of the building is determined by, and its whole strength is made to reside in, a finely organized and frankly confessed framework, rather than in walls. This framework, made up of piers, arches, and buttresses, is freed from every unnecessary encumbrance of wall, and is rendered as light in all its parts as is compatible with strength." This part of the definition is generally agreed upon by all writers and emphasized. We may therefore consider it as the undisputed foundation of the theory and search the monuments for its confirmation.

IV. The next general principle is that of conscious revelation of structure. As Frothingham puts it[1] "every structural element was frankly shown." Mr. Moore states it as broadly also and adds: "We see at a glance that the building is not composed of walls and timber roofs, but that it consists of vaulting sustained by piers and buttresses. . . . In the frank exhibition of each functional member, and the artistic skill with which all are shaped and adjusted with regard to their effect in the mighty whole, reside largely the peculiar impressiveness of the Gothic cathedral."[2]

On the other hand, we find Professor Hamlin bringing out the fact that in certain respects this expression of function did not correspond to the fact;[3] "for the vaulting shafts *do not completely carry the vaulting* they only appear to do so." M. Guadet[4] questions whether this system of abutment in which the interior vaults are sustained by exterior struts, unsuspected on the interior, is not really less expressive of structure than that of some other styles. Further, he and M. Enlart consider the upper arch of the double flying arches of no structural use, as we have already mentioned, thus apparently denying the principle in one of its most significant features. The façades also have often been criticised as not expressing the real structure of the building. Mr. Moore hardly makes his point when he argues that "the façade is merely a storied edifice in which the structural principles peculiar to Gothic are not extensively called into requisition,"[5] for the question is rather whether the structure of the nave is expressed by this exterior.

[1] Sturgis and Frothingham, III, p. 10.
[2] Moore, p. 187.
[3] Hamlin, *Arch. Rec.* XL, 1916, p. 110.
[4] Guadet, II, p. 330.
[5] Moore, p. 178.

There are, of course, many large features of the cathedral in which this revelation of structure holds good, but from the point of view of design the full discussion of this principle is second to none in interest. Enough has been said to indicate that there is distinctly a controversy here, and, as it involves the actual construction, it is one on which one may well hope to find further information after examining the churches laid bare by the recent destruction.

V. One more principle should be included in the theory, that of lightness of construction, as evidenced by the reduction of the piers, the thinness of the vaults, the flying arch and buttress systems, and practically all other parts. This guiding principle is very generally agreed on, the differences being as to its source, whether in "logic," or economy, or sheer virtuosity in constructive technique, or in some more concrete conditions, such as the necessity to reduce the piers on account of the worshippers,—or finally as a part of the Gothic ideal of beauty in design. The outstanding instance of this principle or tendency was the reduction of the wall space in the clerestory and in the aisle or chapel wall, until this became entirely a glazed opening. The result had the greatest effect upon the whole interior aspect, but which of the above causes was responsible for it is again a matter of differing opinion. In all of these cases, the explanations vary according to the different points of view of the authors that we have already mentioned. Though we may not hope to find any confirmation of such non-material causes in our search, we may be led to make certain modifications in our theory which will throw new light on this point also.

We have now reviewed the various broad principles which form the basis of the theory, and the questions in dispute about each.

There is the principle, generally accepted, of the organized framework. Are there important parts in the nave at least, which are other than framework, and how far does this framework correspond to the theory?

There is the question of "logic." Was it the supreme controlling factor or was it secondary to the *appearance* of logic and to purely esthetic considerations in determining the designs?

There is the question of "balanced thrusts." Is there a thrust exerted by the flying arch against the vault, by one vault compartment against another, and by the pier arches or wall arches against each other?

There is the question of "revelation of structure." How much of such structure apparently revealed is real structure? Is there other structure which is not revealed?

There is finally the question of the tendency to extreme lightness of construction. Was it due to logic, or to necessity of one kind or another, or to esthetic reasons?

So much for the statement of the principles. We now come to the leading *features* of Gothic construction, which are usually enumerated as follows, differing somewhat in order of importance according to the different authorities: The vault, with its ribs and cells; the pointed arch used for the ribs and all the openings; the flying arch and buttress, with its pinnacles; the pier with its clustered shafts; the height of the nave; the suppression of the wall; the stained glass windows; the sculpture. Concerning these features there are still many questions upon which critics differ. Such as relate to historical development and dates of construction can hardly be treated here. Though it is quite possible that a careful study of so many monuments as now have their inner structure exposed will lead to important results, yet this study can only be properly carried out on the spot, or at least with photographs of larger scale and more architectural intent than those now at hand. Those questions that relate to interdependence of parts, to the function of members, to their relative importance, to their structural or decorative quality, and to all parts that are ordinarily hidden from the eye, are however within the scope of our study, provided that they can be observed from the limited illustrations now available.

In regard to the ribbed vault, the last word is[1] that the ribs served primarily as centering, that their importance in supporting the vault after it was once erected has been "grossly exaggerated," and that probably the vaults would, in the majority of cases, stand without them, like plain groin vaults. In support of this are cited parts of the ruined vaulting of the abbey of Longpont already in ruins before the war. This is a departure from the former theory that the ribs actually supported a thin shell which filled in the spaces, and the weight of which was carried by them to the points of concentrated thrust.

Another important detail is that of the vault-conoid. This in its lower part is believed to be constructed of heavier stones and

[1] Porter, *Construction of Lombard and Gothic Vaults*, p. 16.

solidly filled, so that it acts as a solid member, together with the ribs at this point, in imparting the thrust to the flying arch and buttress. Evidently its character and function here are not the same as in the upper part. How far this is true is a question for which we may well search an answer in the ruined vaults.

As to the vault in general and its preëminent part in the whole scheme of the nave, how far was it indeed "the central fact," the feature which controlled the whole development of Gothic?

In regard to the pointed arch, the questions that may fall within our inquiry are those relating to its strength in comparison with the round arch, thus perhaps contributing to the solution of the problem as to how far its adoption was due to convenience in regulating the arch heights.

The flying arches and buttresses are naturally of very great interest. We have already seen the open questions that exist in regard to their part in the principle of balanced thrusts; namely, whether the buttress exerts a thrust on the vault or not, and in the principle of revelation of structure, where the assertion has been made that they rather belie than express it in their upper member.

The pier with its clustered shafts is usually treated as a typical instance of Gothic, each shaft being supposed to express its support of the weight from a section of the vault, which is discharged upon it by its corresponding rib. While it might be stretching the theory to take this with perfect literalness, yet this is certainly the impression usually left upon the student. The effects of shellfire upon these shafts, then, will be part of our investigation.

The questions of the minor importance of the wall, or even of its entire suppression and the reduction of the whole building to vaults, piers, and glass, as well as the question of the part played by the window openings in the development of the style,—a question generally considered settled in favor of the vault as the determining feature,—may seem to be beyond demonstration in this inquiry, but if we bear them in mind, we shall perhaps find some light on them also.

As to the sculpture, the questions in regard to it are of meaning rather than structure. Evidently the ruins can give us no light, but in passing, it may be said that the interest is more poignant here, for the loss is indeed irreparable. One may suppose that some of the construction will be rebuilt and that when time has softened and colored the rawness of the new, those churches

which are capable of reconstruction will resume something of their former aspect. But the sculptors and the spirit that animated them are gone, copies by artisans would never be the same, and in this, as in the glass, the churches must probably remain forever mutilated.

II

The Evidence of the Ruins

Before discussing in detail illustrations of the monuments, several general observations may be made. We have already spoken of the possibility of discovering more about the realities of the construction. But we may hope to learn not only from the broken portions, but also from those that are more or less hidden, such as the upper side of the vaults, the roof, and its relation to the wall or piers. Further, we shall see the structure in some cases somewhat as the builders saw it. Since the architects or master builders of those days lived on the works and the half-completed buildings must have entered into their conception far more than is the case with the architects of to-day, we, on finding ourselves in their position, may gain somewhat more of their point of view than by always reasoning backward from the finished church. May we not say, indeed, that only thus can we free ourselves from the tendency to see a logical reason for every feature, since the logical explanation is the most natural one for a scientifically-minded historian, archaeologist, or critic to seek? Of the many invisible paths that may have led to the visible result,—material difficulties, failures, caprices, survival of tradition, or strict logic,—is not that of logic the one most likely to be sought for, and its imaginary trail found by a reasoning, classifying generation.

Finally, the geometrical drawings in our books, especially the sections, taken as they usually are through the openings rather than through the pier, tend to be misleading. For instance, from them we readily assume that the vaulting conoid was largely solid with filling or that the flying-arch buttress was developed from the continuous abutting barrel vault of Romanesque work. This latter assumption is probably correct, though questioned, but it is certainly much favored by the similar appearance of the two features in the usual geometrical sections.

A question naturally arises at this point about the effects of shellfire in general upon such buildings as the Gothic churches. Broadly speaking, it may be said that the simplest, and rarest, effect is the piercing of a roof or vault by a projectile without explosion, for usually the explosion takes place at the point of contact. In case of a fracture or explosion, the flying or falling fragments may cause further destruction to anything around or below them. In addition to all this destruction there were, in some cases, incendiary shells, as at Rheims, where great numbers of such shells were fired upon the cathedral, causing the destruction of the roof and flèche by fire.[1]

The direction of these projectiles was probably vertical in the case of air bombs and nearly so in the case of shells, which being of long range would drop nearly straight. Even a slight angle, however, or a shell-burst beside a wall or pier would give the impact a certain direction.

In addition to these effects, there is always the possibility of more than one hit producing the result that we see. At Soissons and Rheims, at least, we know from successive photographs in different years that the destruction was thus progressive.

From all this, it is clear that in such a welter of destruction as came upon some of these finely organized and delicate constructions one must be very cautious about saying *how* a given result happened; often the most that can be done is to note what parts are standing independently of others adjacent to them, and draw only such inferences as can be made from this. And even here, one should use judgment in ruling out the eccentricities of stability that are so often seen in the ruins of fires and explosions. For the purposes of indication as to the truth one may, I think, assume that the same case occurring twice is not such a mere eccentricity.

[1] It may be of interest to note that the fire of the scaffolding on a corner of the main façade was not the cause of the destruction of the roof, as is sometimes stated, for there were four other centres of the fire (*L'Art et les Artistes*, p. 44). Nor was it the cause of the burning straw inside, which caught from the shells (*Les Monuments français détruits par l'Allemagne*, p. 57).

TABLE OF FEATURES AND PRINCIPLES

RESULTS NOTED, BY "FEATURES"	ILLUSTRATIONS	PRINCIPLE, CONFIRMED OR NOT
1. Ribs carry vault and so concentrate its thrust.	Figs. 1a, 4b, 6c, 8, 17.	Logic, confirmed. Revelation of structure, confirmed.
2. Do not carry vault in lower portion.	Figs. 2b, 4c, 13 (2 holes).	Logic, contradicted. Revelation of structure, contradicted.
3. Diagonal ribs give more support to vault than others.	Figs. 1a, 2c, 5, 6abd.	Revelation of structure, contradicted. Balanced thrusts, confirmed.
4. Flying arch—no thrust on vault.	Fig. 2d.	Balanced thrusts, contradicted.
5. Flying arch—upper tier too high, slight value as abutting vault.	Figs. 2f (5 same).	Balanced thrusts, contradicted.
5a. Flying arch—upper tier broken.	Figs. 2d, 14a.	Same as 5.
6. Buttress pinnacle—very light.	Fig. 14.	"Pinnacle" theory, contradicted.
7. Vaults—adjacent nave compartments *not* interdependent.	Figs. 1c, 6a.	Balanced thrusts, contradicted.
8. Vaults—importance compared to wall has been exaggerated.	Figs. 2k, 18.	Theory contradicted.
9. Vaults—height of filling.	Figs. 2ce, 3b, 4a, 5, 6b.	Theory confirmed.
10. Vaults—this portion of conoid self-supporting, independent of ribs.	Figs. 2b, 5, 6b.	Revelation of structure, contradicted.
11. Level crowns.	Fig. 7.	Theory well illustrated.
12. Cells adjacent to diagonal rib not interdependent.	Figs. 1, 2c, 4c, 6d.	Balanced thrusts, contradicted.
13. Lightness of construction, Soissons.	Figs. 2c, 5, 6 def, 18.	Lightness, confirmed.
14. Thickness of vault construction, Rheims.	Fig. 13.	Lightness, contradicted.
15. Vaults independent of wall.	Figs. 2k, 4a, 18.	Mediaeval point of view.
16. Arches of clerestory not interdependent.	Figs. 2, 3, 5.	Balanced thrusts, contradicted.

Results, noted by "features"	Illustrations	Principles, confirmed or not
16a. Pier shafts—not structurally essential.	Figs. 1f, 4d, 5.	Logic, contradicted. Revelation of structure, contradicted.
17. Wall—thinness.	Figs. 1d, 3c, 6 ef.	Lightness, confirmed.
18. Wall—importance, between clerestory windows.	Fig. 2k.	
19. Suppression of wall.	Fig. 1bc.	Theory confirmed.
20. Organized framework of structure.	Figs. 1e, 5, 6g.	Theory confirmed.
21. The roof: importance.	Figs. 2, 12.	Revelation of structure, contradicted.
22. Transverse wall under aisle roof.	Fig. 6h.	Revelation of structure, contradicted.
23. Parapet, decorative, its importance.	Figs. 7, 12.	Logic, contradicted.
24. Suppression of clerestory wall, decorative rather than logical.	Figs. 7, 12.	Logic, contradicted.
25. Tower at crossing,[1] light, decorative.		Logic, contradicted.
26. Lack of correspondence, nave and façade.	Figs. 7, 8, 9, 10, 11.	Logic, contradicted.
27. Structure nearly complete without vaults.	Figs. 2, 19.	Mediaeval point of view.
28. Upper tier of flying arch hardly abuts vault filling.	Figs. 2def, 6e.	Mediaeval point of view.

Before beginning our discussion, it may be said that inasmuch as the theory is based on a few of the very greatest cathedrals and is especially exemplified by them,—although by most critics it is no longer limited to them,—we shall confine our evidence to what may be selected from ruins of that class.

Something indeed might be learned from the many smaller churches illustrated in "*Les Monuments*"[2] but the evidence is much scattered and many of the churches are of later date or from regions where Gothic was less perfectly developed.

As a matter of fact it was two of the greatest monuments, Rheims and Soissons, which underwent the most terrific bombardments, and it is from them that our evidence will be drawn.

[1] See Viollet-le-Duc's illustration of Rheims in the thirteenth century, Sturgis and Frothingham, III, p. 47.

[2] A. Alexandre, *Les Monuments français détruits par l'Allemagne*, Paris, 1918.

Laon, Amiens, Beauvais, all most fortunately remain intact. Noyon, Senlis, and scores of small churches are more or less destroyed. At present, illustrations of these are not available, but, valuable as the studies of them must be from the point of view of historical development, they can hardly have the bearing of this great pair on the fully developed theory.

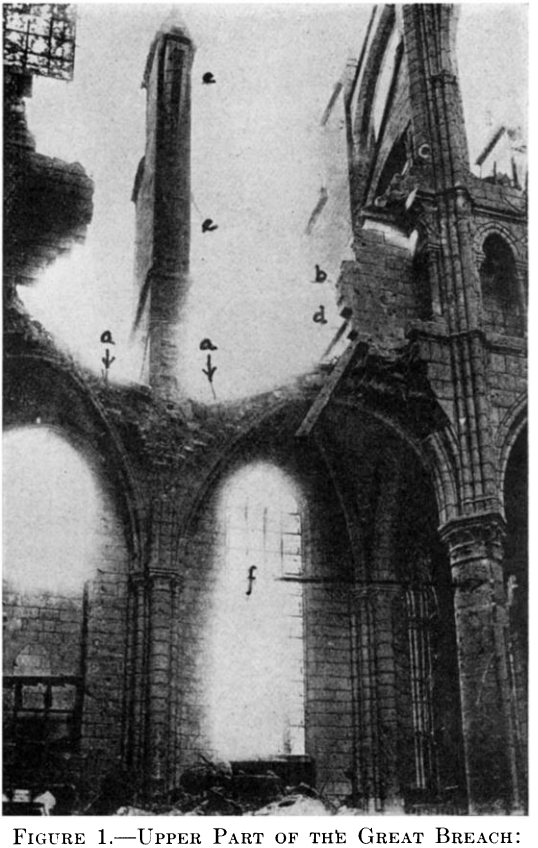

FIGURE 1.—UPPER PART OF THE GREAT BREACH: SOISSONS.

At this point let us pause a moment for a further examination of the very interesting case shown in Figure 1. If we knew with any certainty where the shock or explosion had occurred that caused this wreck and in what succession the parts had fallen, we should be able to obtain much real light on the principles of Gothic. In fact, this seems to be the most important piece of ruin that we have in all the available illustrations. Let us then see what steps, if any, we may safely take in our inquiry.

In the first place, we may say that it was not merely the vault that was hit and carried the other parts down with it, for in Figure 2, we see that the vaults may fall without disturbing any of the rest of the structure.

If we assume that the lower tier of the flying arch, which as

is shown by Figure 2, is the essential one for the stability of the vault, was broken or indeed both tiers, *without the wall or pier being hit*, we assume a case of great interest, but of extremely small probability, for the hit would have to be right on the lower tier buttress or close beside it. Moreover we might expect to find some "spatters" on the inner face of this buttress or the adjacent flying arches or buttresses, which do not appear (Figs. 1, 2, 3). The spatters on the left side of the buttress itself (Fig. 3) would hardly be caused by so direct a vertical hit. Again by our theory we should expect the vault to have burst outward, whereas the pile of débris (Figs. 4, 5) seems to indicate that everything fell vertically, the pile being greatest where there was most masonry above it. So although one is at first tempted to say that here for once we have a case of the buttress being cut and the vault and pier bursting out and crashing down in consequence, we should be running counter to too many probabilities to have any real confidence in it.

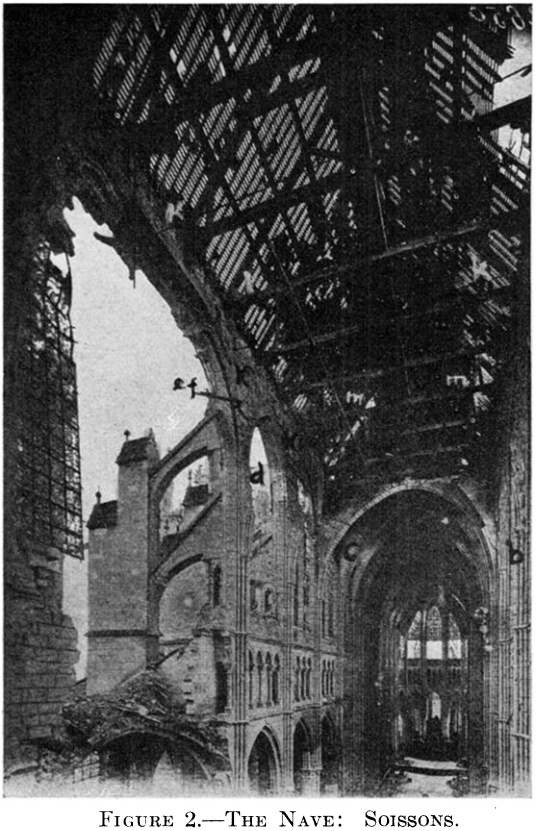

FIGURE 2.—THE NAVE: SOISSONS.

If, however, we suppose that a shell in a somewhat slanting direction struck the vault of the aisle or the wall somewhere near the line of the pier at a height anywhere between the abacus and

the top of the triforium, we might perhaps get this result. The pier would fall inward, breaking off the flying arches and letting the vault down with it. The aisle vault might be broken by the shell, as shown in Figure 1, or by the falling buttress. The spatters might be diminished by the soft mattress-like aisle-roof (Fig. 6). The occasional spatters seen in Figure 1 on the inside might be caused by fragments from the débris as it struck. This hypothesis appears to satisfy the conditions found and still permits quite a range of possibilities for the shot itself.

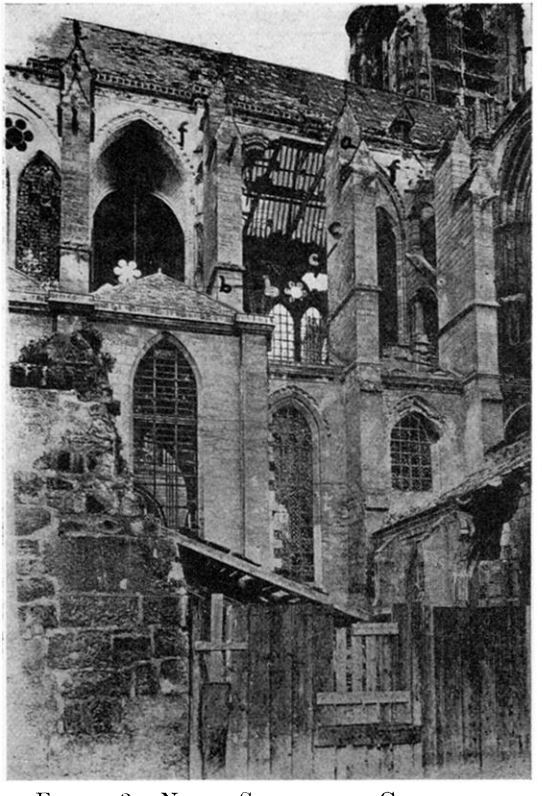

FIGURE 3.—NORTH SIDE OF THE CATHEDRAL: SOISSONS.

It is unfortunate however that it seems to be the most likely, for if this was what happened, it gives us really no interesting light on our theory, except perhaps on the lightness of construction and organization of the whole bay. The foregoing analysis however will serve to show how difficult it is to guess just how the different cases of collapse occurred and how unsafe it is to deduce much from that branch of our inquiry.

Having observed carefully the facts exposed in the illustrations of the ruins and having correlated them according to the features to which they belong and the principles involved, let us now return to the general theory of Gothic and its open questions

(p. 42) and see how far the one is borne out by them and the others answered.

The strongest impression left by such a study of these churches is certainly that of their organized framework. The more their scheme is laid bare in these terrible sections, revealing interior and exterior together and all in perspective, the more we feel their ingenious system, so different from the ruins of all other architecture. We see for instance a great buttress intact but severed from the body of the structure in as clean cut a division as that of an amputated limb (Fig. 1, e). We see a whole bay wiped out but the breakage lines following almost as closely the structural and architectural divisions as if it had been a vertebra (Figs. 1a, 3b, 5). We see indeed a more organic structure than we had expected in that the vaults themselves have come away, leaving the walls clean (Fig. 2). In fact we are struck with wonder that masses of steel and the highest explosives could be hurled into this rich, almost fragile, network of stone and yet the destruction be so limited, so confined to units actually struck.

FIGURE 4.—NAVE AND NORTH AISLE: SOISSONS.

On further reflection, however, we come to realize that the framework revealed here is not altogether that of the theory.

We have been used to thinking of the structure as composed of vaults, piers, and buttresses but we now realize that the clerestory arches and the wall between them and, at Rheims, above them (Fig. 7), are also finely organized and quite as finely built (Fig. 2). We feel, in view of the ease with which the nave vaults can be stripped away, that this arched wall must be added to our statement of the frame.

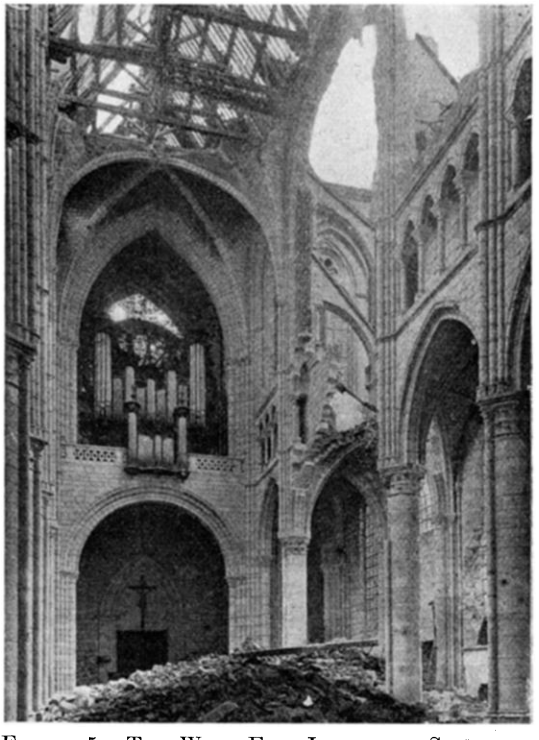

FIGURE 5.—THE WEST END, INTERIOR: SOISSONS.

Again, we see the façade as a great and massive structure quite capable of standing alone. In fact so nearly is it a complete composition in itself that it is hard to realize in looking at it from the rear that it is a façade and not a separate structure (Fig. 8). If we now look at another ruin near by, St. Jean des Vignes at Soissons (Figs. 9, 10), a relic of the French Revolution and one of the most beautiful though least known ruins in Europe, the same fact comes home even more strongly. Finally at Rheims (Fig. 11) the flying arches of the nave seen through the openings of the towers show the slightness of the relation between the whole composition of the façade and that of the nave, as at Soissons we saw the lack of structural relation. This whole matter of the façade however is also a question of exception to the principles of logic and revelation of structure, as well as of organic frame, and therefore will be considered further in those connections.

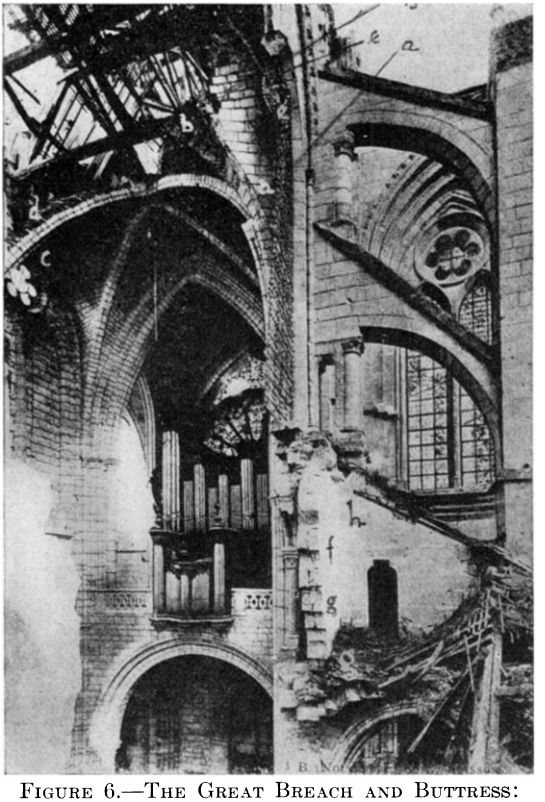

FIGURE 6.—THE GREAT BREACH AND BUTTRESS: SOISSONS.

As regards the organic principle we must consider that perfectly as these façades express it within themselves, they now appear more clearly than ever as a frank departure from it in relation to the main body of the church.

And now we find ourselves asking the inevitable question, the crux of the whole matter. Was "*logic*" then,—the logic of the essential in construction,—the guide as well as the law by

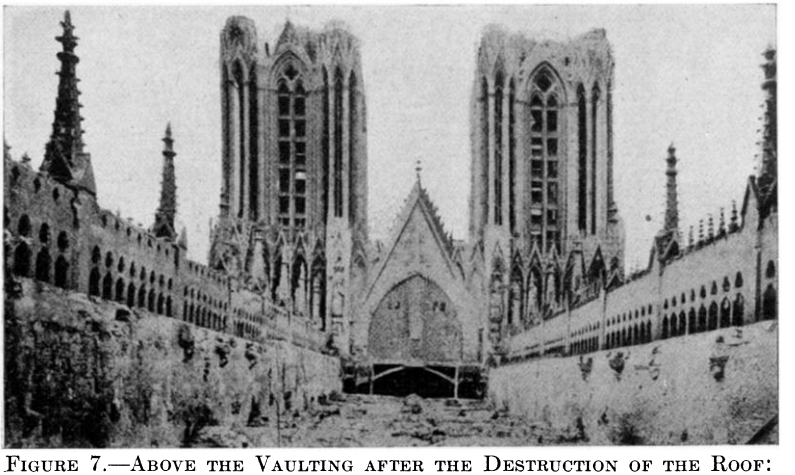

FIGURE 7.—ABOVE THE VAULTING AFTER THE DESTRUCTION OF THE ROOF: RHEIMS.

(*L'Art et les Artistes*, p. 50.)

which and under which these cathedrals were designed? Undoubtedly, we shall answer, their designs were penetrated to a very great extent by architectural reasoning, and especially so in the vaults and their ribs, for these are essentially an affair of construction. Possibly just because the problem was so difficult,

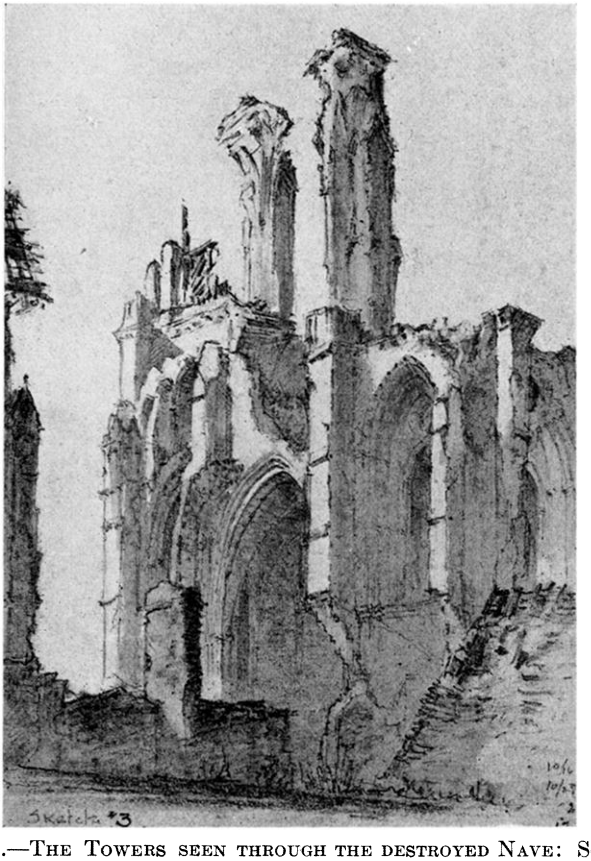

FIGURE 8.—THE TOWERS SEEN THROUGH THE DESTROYED NAVE: SOISSONS.
(Drawn in 1918 by the author.)

so rigid, it was here handled very simply. The absolute protection from a burning roof afforded by them to the rest of the structure, as proved at Rheims, the shape of the vaults, their small stones, their lightness, their level crowns, their conformation to the stilted wall ribs to concentrate their thrust, all seem to be based on an ideal of construction only. And yet we know

that in their most fundamental quality, that is their immense height, they were *not* controlled by logic, but by an ideal. This ideal desire for height, and always greater height, was the source of some of the greatest problems, in fact the cause of the whole system of exterior abutment with its risks and its costly construction.

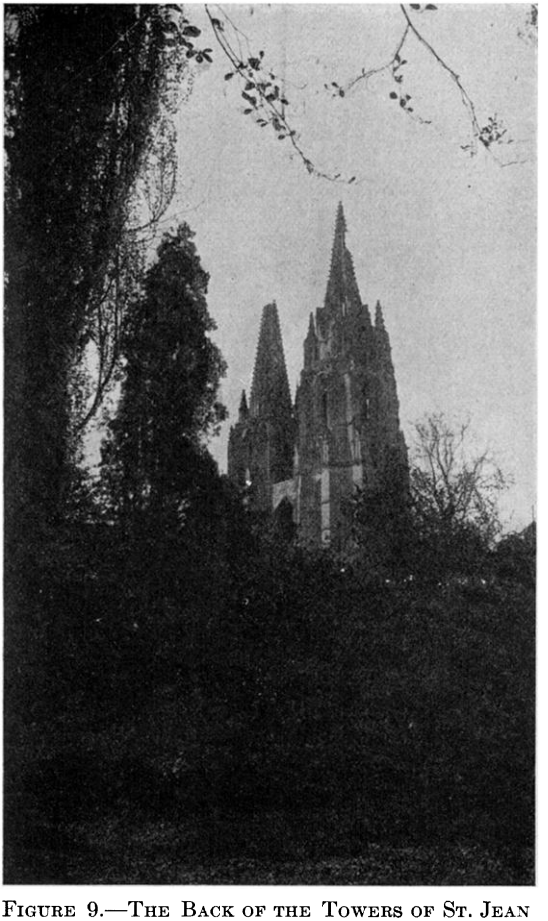

FIGURE 9.—THE BACK OF THE TOWERS OF ST. JEAN DES VIGNES, BEFORE THE LAST BOMBARDMENT.

But when we find in the statements of the theory that this architecture was primarily based upon the complex dialectic of the middle ages,[1] or that, to quote one of the latest histories,[2] "not an atom of the structure was irrelevant — nothing vital was left to whim or chance. The laws of beauty were subordinated to the laws of scientific life"—we feel the challenge of absolute logic. What then do we actually see? At Rheims we see a great wall rising to some distance above the extrados of the vaults and running all around the perimeter of the building (Fig. 7), and, above this again, a rich

[1] A. K. Porter, *Beyond Architecture*, pp. 37ff.

[2] Sturgis and Frothingham, III, p. 29.

and purely decorative parapet with pinnacles,[1] a very considerable effort on the part of the builders (Fig. 12); we see the construction for the light and purely decorative tower at the crossing which must have played an immense rôle in the general exterior effect of the original thirteenth century edifice. Again we see (Fig. 11) through the arches of the towers, more clearly than before, the vast difference between the size and shape of the body of the church and its façade. All these are, quite simply, not "dialectic," not "the laws of scientific life." Such sweeping extensions of the principle do not fit the cathedral at all. The truth is that the building is logical, but not exclusively so.

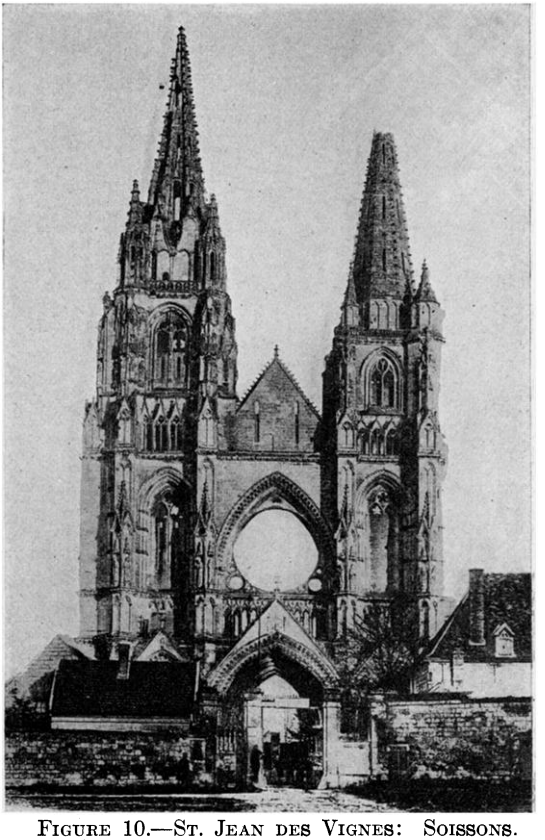

FIGURE 10.—ST. JEAN DES VIGNES: SOISSONS.

Now the designer who did these things was not governed entirely by logic, strict economy, and the like. Not at all. He departed from "logic" altogether at times and built into his cathedral parts which meant extra load on his slender piers and great expense, "purely unnecessary expense" as the current phrase has it. Being that sort of a man, he undoubtedly did other things in the building which were also as "unlogical" and decorative.

[1] Compare the very low parapet at Soissons (Fig. 3), which is all that necessity requires, as I have personally proved.

With this established one may perhaps obtain a light on some other hypotheses,—or problems. One of these is the suppression of the clerestory wall. Was it the fascination of the logical conclusion in finding the wall unnecessary that drove such a man to substitute a glass wall for a stone one, and this in spite of the fact that the glass must certainly have been more expensive as well as less permanent? For whatever the expense of the glass, nothing is simpler or cheaper in France today than plain ashlar, such as this wall would have been, and, judging from the mediaeval skill in masonry, it could hardly have been otherwise then. And if we are still in doubt, we may compare the amount of continuous wall which he built *above* his clerestory arches, quite contrary to the structural requirements. Here also one may well doubt the part of logic and feel free to trust the lure in the beauty of the glass itself as the real motive for suppression of the wall.

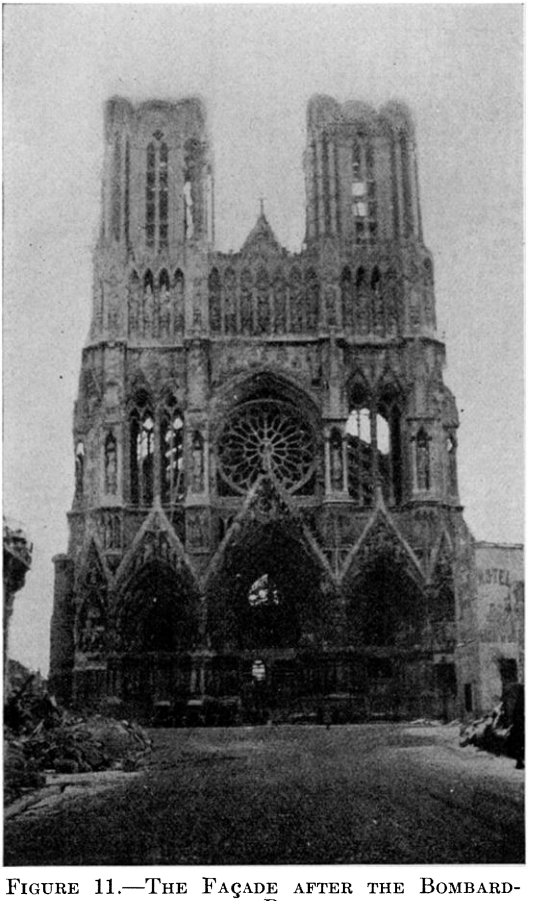

FIGURE 11.—THE FAÇADE AFTER THE BOMBARDMENT: RHEIMS.

Closely connected with the principle of logic is that of the *revelation of structure* for esthetic effect. Here again the ruins

generally illustrate the theory and confirm it in its broad application. In the vaulting, the manner in which the breakage has occurred, as well as its extent, does confirm strikingly the theory that the ribs carry the vault cells and are not only real functioning members, but are the most important part of the vault. The cases where the whole cell has fallen as far as the rib, are not only more numerous than those of the opposite kind, but the latter themselves usually show breaks following the rib's direction, although they may not come quite to it. In this, moreover, the facts seem to disprove Mr. Porter's view[1] that the function of the

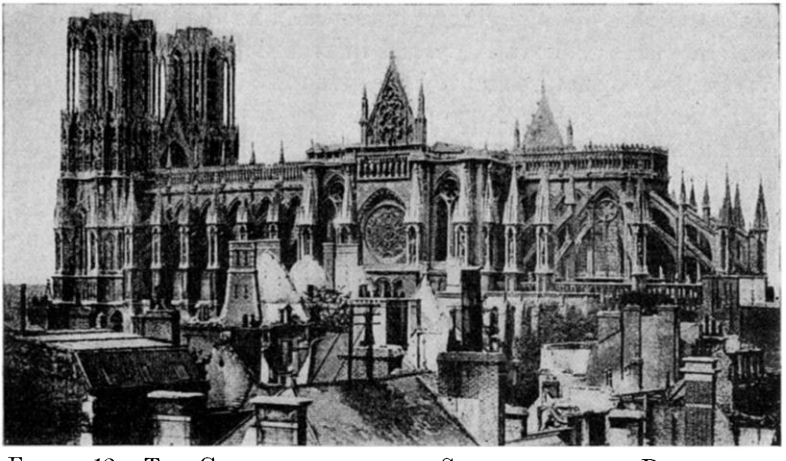

FIGURE 12.—THE CATHEDRAL FROM THE SOUTH AFTER THE DESTRUCTION OF THE ROOF: RHEIMS.

ribs in supporting the vault has been "grossly exaggerated," being primarily for support of the wooden centering, and Brutails' statement[2] that the rib was in theory for support but in fact for appearance.

In regard to this general principle, however, there seems to be some confusion of thought. In the case of the vaults and their ribs it is apparently a principle of convenience, to be made use of where there was an effect to be gained. It is a principle expressed in much other architecture, as in the dome of the Pantheon, the high undecorated architrave emphasized as the working member of the Greek entablature, and so on. Similarly the

[1] Porter, *Construction of Lombard and Gothic Vaults*, p. 16.
[2] Brutails, *op. cit.* p. 153.

Gothic builders emphasized their vault ribs. Indeed there is an almost inevitable quality in the way the beautiful Gothic effects are bound up with their necessities, as, for example, the unsurpassed perspectives of their interiors, due to the structural working out of their aisles; transepts, and ambulatories, which yet seem, and perhaps are, necessarily imposed by the ritual. In fact we may truly say that the chief sources of esthetic effect in the interior are indeed those of the revealed structure, with the one notable exception of the stained glass.

It sometimes happens that such a principle is transformed in the mind from a means to an end in itself. Then it becomes thought of as a *law* of style and universal in its application. This is what seems to have happened in regard to this principle of revelation of structure and to have given rise to the point of view found in the books. Now this in fact amounts to ascribing certain feelings and a mental point of view to the mediaeval builders, which makes such statements humanly interesting at once, and gives the history of Gothic a dramatic, even a moral character. But it is at least venturing into another field, and one may raise the question whether the attribution of such a point of view should not be confirmed by, if not based on, the evidence of documents as well of executed designs. Among the historians this seems to be lacking and even in the quotations of so thorough an author as Mr. Porter, who goes the most deeply into documents to explain the mediaeval point of view, nothing of this sort appears. For its confirmation therefore we are limited to the monuments themselves.

Now actually we find that some of the cases often considered as revealed structure are not the real structure. At Soissons the single shaft on the lower story of the nave piers does not really support the vaulting shafts and, in turn, the vaults above (Figs. 1f, 4d, 5). The objection to this as an accidental case would be met by the fact of the very slight connection between the shaft and the pier, shown in the break,—not enough for the shaft to add to the strength of the pier. It by no means follows that the shaft is not good design, only that it does not express the facts of this structure; it is in fact an eye-satisfying fiction, although perhaps, a proper one.

Again let us take the case of the flying arch and its buttress. If we carefully notice the point of abutment of the arch's upper tier at Soissons (Figs. 2f, 6e) in relation to the height of filling of

the vaults (Figs. 2c, e, 4, 5, 6b) we shall see that probably only the lower edge of the flying arch abuts the filled or solid portion of the vault; the upper edge appears to abut, if the term may be used, only the wall. At best this is hardly a sufficiently good connection to warrant the second tier of the buttress; we may at least question whether it, like the pier shaft, is not an expression of structure which does not correspond to the real fact.

In the second place, we find in our ruins some cases of structure which are not revealed. One of these might have been seen before, though it is now made more clear than by drawings,—the filling of the lower half of the vault conoid and the possible transference of the thrust from the ribs to this solid portion (Figs. 2b, 5, 6b).

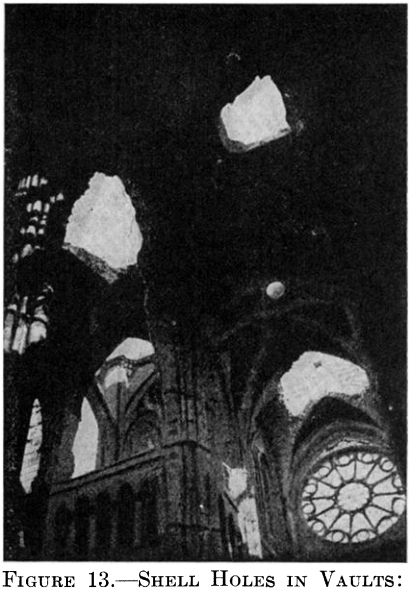

FIGURE 13.—SHELL HOLES IN VAULTS: RHEIMS.
(*Mon. franç.* Pl. 4, 1.)

The word possible is used advisedly, for from the appearance of the filling (Figs. 2c, 4a, 6d, 18) it appears of doubtful value for any such purpose, and more like a mere addition of weight. It seems from the illustrations as if it were the heavy walls of the upper part of the solid portion, self-supporting almost without the rib, that were its strength. Thus the solid portion performs a quite different function from the rest of the vault, a function which is not revealed.[1] This is in one way a small point, but in another it is not, the design as executed contributing very largely to that impression of the vaults being supported entirely on the interior. For this the ribs and shafts also were in large part designed.

Another similar case is found at Rheims where one photograph[2] shows apparently cross-bracing walls above the vault, and these abutted by the upper tier of the flying arch. This

[1] The larger stones in the shell of this part hardly express such a difference.
[2] Kimball and Edgell, *History of Architecture*, p. 287, fig. 144.

interesting construction appears in only one of the Rheims photographs and apparently did not occur at Soissons. It seems to show that the upper tier of the flying arch did not perform the part that it appeared to perform but another, which was not revealed.

Again there are the diagonal ribs which in both nave (Figs. 1, 2, 6, 13) and aisle seem to limit the breakage, in other words to be the strongest ribs of the vault, or the limits of its structural divisions. And yet this is not revealed by a larger section of the diagonal ribs; on the contrary it is the heavy and wide transverse rib which appears to express such a function.

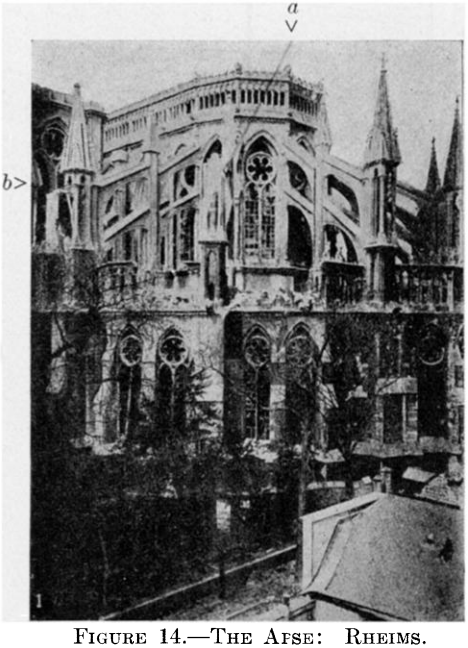

FIGURE 14.—THE APSE: RHEIMS.
(*Mon. franç.* Pl. 3, 1.)

Then there is the structure of the roof, so much in evidence in the illustrations of Soissons (Fig. 2). Shall we dismiss this as "not the true roof,"[1] not important enough in the whole design to demand any revelation of its structure or of its method of support? We know its weight was about two-thirds that of the vaults,[2] a load which the designers had certainly to reckon with. Also, it did have a decorative value as may clearly be seen by the comparison of Rheims before and after its destruction (Fig. 12). And it was an organic structure, with its trusses corresponding to vault ribs, a structure which one may suppose could have been expressed, if the builders had wished it, instead of leaving it the plain unified surface that they did.

Finally there is the façade itself. The discussion about the greater or less lack of its relation to, or revelation of, the main

[1] Moore, p. 170.

[2] In St. Ouen at Rouen the load of roof on each pier is 12,000 kg.; that of vault, 20,000 kg. Guadet, II, p. 344, fig. 1096.

body of the building is not new; our clearness of vision is, however, now greatly increased. At Rheims, the flying arch-buttresses of the nave seen through the openings of the towers show the slightness of the relation between the whole composition of the façade and that of the nave. In St. Jean des Vignes at Soissons, the nave of which was destroyed many years ago, the façade appears as a great and massive structure in itself (Figs. 9,10). In fact so nearly is it a complete composition that one can hardly realize in looking at it from the rear that he is not seeing the front. Finally we study the same point in the cathedral of Soissons from a photograph taken before the final bombardment (Fig. 15) and from this sketch, taken after the Aisne drive of June, 1918 (Fig. 8). Here we are looking through the break in the nave toward the back of the façade mass and realize with astonishment that the comparatively small arch in the centre corresponds to the outline of the whole nave vault, the arches on either side being wholly outside the nave, on the back of the tower base. We then turn to the façade (Fig. 15) and see the expression, so simple and direct, of something which is not at all the building itself. Is it possible that to the

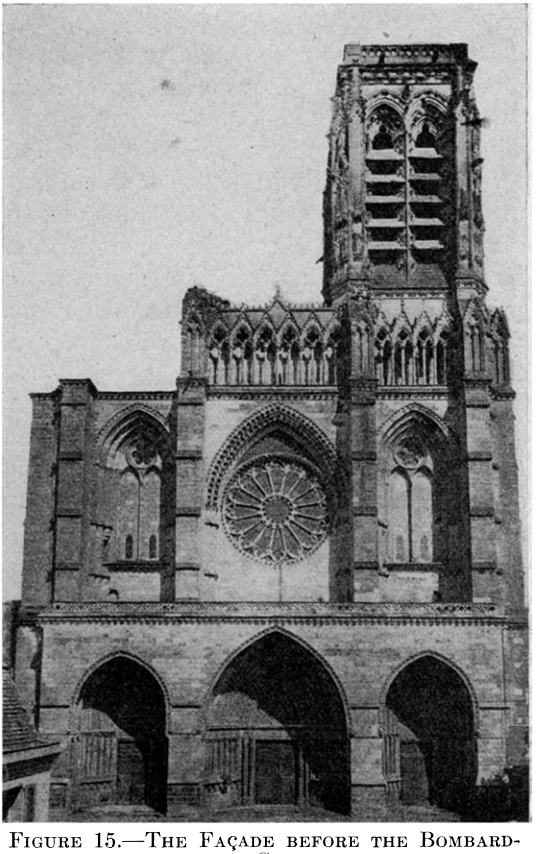

FIGURE 15.—THE FAÇADE BEFORE THE BOMBARDMENT: SOISSONS.

men who built these façades revelation of structure was a controlling principle in the sense that it has become for us, in our books? If we quote the charming design of Sainte-Nicaise,[1] now known only from drawings, as a truly developed Gothic façade, then these are not, nor are most of the others. Why force the principle into a law which leaves such façades as these to be its exceptions?

In all these cases, the builders must have been perfectly aware of what they were or were not revealing. The pier shaft, the upper tier of the flying arch, which they looked down upon and climbed over for months, if not years, during the construction, the different quality in the lower end of the vault, the cross walls under the roof, the more important diagonal ribs, the roof construction,—all of these they knew with an intimacy that no modern designer knows in his buildings. And by all of them the principle of all-pervading conscious revelation of structure is denied. Certainly it will be wiser in future to limit ourselves to a far simpler statement.

And now we come to the principle generally called the *balanced thrust*, sometimes considered the most fundamental one of the style.[2] Its simplest case, and the best understood, is that of adjacent arches, where the haunch of one shoulders the haunch of the next and so on down the nave. According to the theory, if one is removed the rest tend to fall, like a line of dominoes, and it is by thus balancing the thrusts of these haunches that they all stand. Now, if we look at the clerestory and nave arches of Soissons (Figs. 1, 2, 3, 5), we see a case in which the arches on either side of a breach stand perfectly well without their neighbors' counter-thrust, and this in spite of such terrific shocks to the whole frame of the structure, as could have caused these successive ravages.

The next case of adjacent thrusts balancing each other is supposed to be between the adjacent cells of the vaults or two adjacent diagonal ribs. Now as between the cells, this principle does not seem to be proved at all by the manner in which the cells remain (Figs. 1, 2c, 4c, 6d). It appears to be the ribs, especially the diagonal ones, which carry the vault cells and the thrust of the latter stops on them. In the cases of the diagonal

[1] Sturgis and Frothingham, III, p. 110.

[2] Sturgis and Frothingham, III, p. xxix.

ribs that are intact, the evidence seems to be conflicting. In Figures 2c and 6d only one diagonal vault rib remains, a contradiction of the theory; in 2b, 4a, and 6a there is the lower solid half of the vault conoid remaining, which may balance the adjacent rib, a confirmation of the theory. In the aisle vaults (Fig. 1aa) the diagonals of two vaults are both intact, but we have already reasoned that the counterbalancing diagonals that met on the missing pier probably went down from some cause other than the action of the thrust of one after the other was destroyed.

As to the main compartments of the nave vault, they do not balance each other, as may be seen by comparing some of the successive steps by which they fell (Figs. 2, 5, 8, also in table, No. 7). In searching for all the possibilities of the balanced thrust this case should be taken into account. It is sometimes stated, on the other hand, that these compartments were not intended to balance each other and that this was an advantage in construction, which now appears to be the true view.

But it is the case of the flying arch and the vaults, that is most cited as the outstanding example of this principle. Now in the sense that we have been using it, there is no balance of *active* thrust here worth mentioning. If the flying arch exerted much thrust against the vault, when the latter fell, the former would push the slender wall in. But we have here several cases where there has been no such effect on the wall at all (Figs. 2d, f, 6f). There was always equilibrium, of course, and the vault's thrust against the flying arch, but this latter is, in fact, little more than a strut or prop, that receives this thrust and transmits it to the large outer buttress. Transmission of thrusts rather than balance is what we find to be the truth of the case.

This may be seen more clearly by a drawing (Fig. 16)[1] in which the size and position of the buttress as ideally worked out by structural mathematics, are shown, together with an actual buttress of the church of St. Ouen at Rouen. Here the flying arch, as scientifically calculated, appears in its real character of a prop pure and simple. Of course, the lines of this ideal prop are not the only ones that will serve. The actual system is an artistic approximation, a roundabout but more pleasing method of performing the same function, just as the complicated broken curves of the great English timber roof trusses approximate

[1] After Guadet, fig. 1096. The temporary emergency supports built under fire at Rheims are reported to be of this form also.

the straight lines of certain truss forms, by virtue of which they perform their work.

At this point the question arises inevitably whether the Gothic designers knew what this mathematical form, this scientific minimum, was. Undoubtedly[1] they did not know how to find it mathematically. Whether they knew that their usual form was as far removed from the bare necessity as it was, may be guessed from our inferences about their revelation of structure. If we believe, as it seems we may, that they were men who designed in general conformity to the actual structure, but enlarged freely upon this where it seemed inadequate, we may equally believe that they had learned in their earlier examples,[2] or in their worksheds, approximately what the necessary lines of the flying arch were, but preferred to satisfy the conditions by freer, more architectural forms, such for instance, as those found at Soissons.

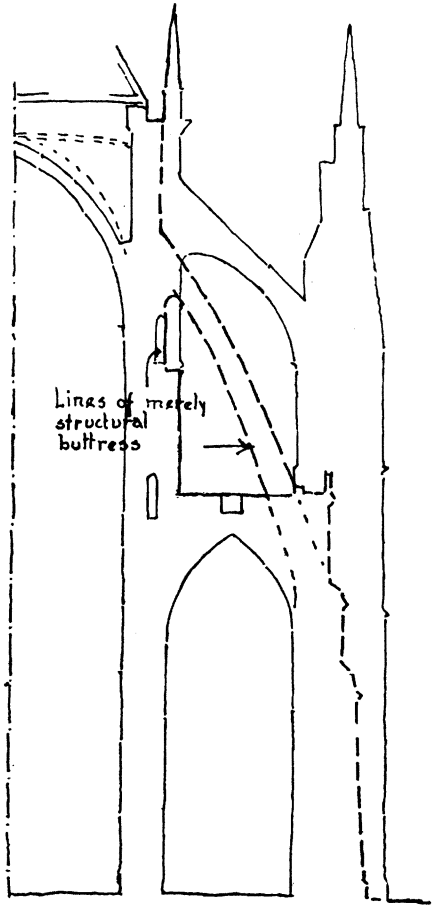

FIGURE 16.—SECTION THROUGH PIER, ST. OUEN: ROUEN.
(After Gaudet, II, Fig. 1096)

What then shall we say of the general principle? Simply, that in this case, it was really a transmission of the vault thrust to a buttress, placed at some distance, while there was some balance of thrust of adjacent diagonal ribs on the pier.

[1] Gaudet, II, p. 331.

[2] For example, at Noyon, illustrated in Moore, fig. 74.

But at the same time, we should recognize this transmission of thrust as a really great innovation, as original as it was bold, and as successfully handled as it was characteristically Gothic. Instead of the "living forces" constantly at work throughout, "combating each other," we may better confine ourselves to the actual vaulting system and the transmitted thrust, as being really a new architecture; and we shall find in its skill, originality, and beauty sufficient cause for our admiration and study.

There remains one more general principle, the *lightness of construction* and its determining cause. Among the smaller ruins, there are several striking cases of the lightness of vault construction, the cells being mere shells of such thin stones that they have rattled down almost like tiles (Fig. 17). And at Soissons, the nave vaults are so light that some of them seem to have collapsed, ribs and all, from so slight an explosion that it did not destroy the roof at the same time. It may have been that a shell merely pierced the roof (Fig. 2m) and the vault or that one entered through a window (as at Fig. 2d) and shattered the delicate cells and ribs from below. If one asks whether the two vault-bays adjacent to the great breach did not follow its vault of themselves in obedience to the principle of balanced thrusts, we may refer to Figure 5, a photograph at an earlier date, and see this one bay gone and the others intact. At Soissons, the walls, also, are extremely thin (Figs. 1d, 3c, 6ef), especially the upper wall, which is only the thickness of one stone, and that merely thicker than the plate tracery by some slight reveal at the billet mould (Figs. 2f, 6e).

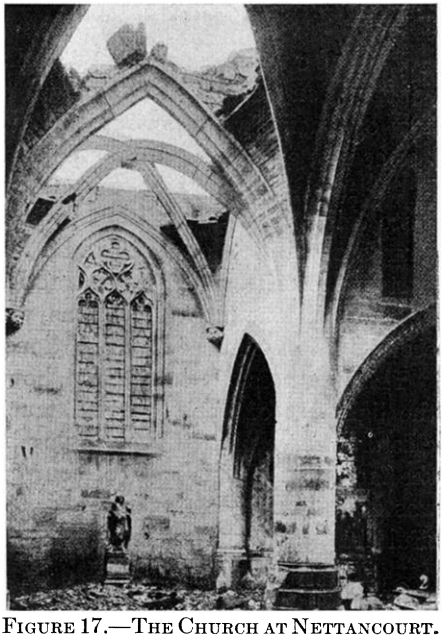

FIGURE 17.—THE CHURCH AT NETTANCOURT. (*Mon. franç.* Pl. 13, 2.)

At Rheims (Fig. 13), on the other hand, the vaults are decidedly heavy and show no signs of collapsing. Evidently, the shells have torn only a definite hole in the splendidly built vault.[1] This same strength is seen in the great wall and parapet (Fig. 7). In fact, it is commonly said in France that the vaults of Rheims had the heaviest cross sections of any cathedral, that it was built like a fortress, and that it is due to this, that the vaults have not fallen altogether in the later bombardments. It might be added that it was due also to the devotion of the French soldiers, who climbed up and built the necessary supports of masonry under bombardment when the continual shelling of the crossing-vault threatened to succeed in wrecking the whole centre of the edifice.

What the underlying motive of the general lightness of Gothic construction was, may be disclosed to some extent by a comparison of Rheims with Soissons. The latter is in every respect a less costly, as it was a less important cathedral. A mere glance at the façade, at the pier capitals, at the roof parapets will illustrate this. Rheims was built to be the royal, the most splendid church of France, and the same lavishness shown in all these parts was carried into the construction. Conversely, the lightness of the construction of Soissons was clearly due to the same economy shown in the other portions.

This lightness of construction, however, is another matter from the lightness of effect, carried much further at Rheims, in its clustered nave piers, lighter flying buttresses, slender turrets on the façade. All this was, of course, not at all an economy and was done from a love of the effect itself, one of the most beautiful characteristics of Gothic.

Of the various outstanding problems in regard to the features of the cathedrals, most have been noticed already. Just what the controlling reason was for adopting the pointed arch in preference to the round, and whether this query, seemingly so purely archaeological, may be elucidated by the ruins, remains to be discussed. We have, indeed, seen that the diagonal ribs generally stand while the others fall (Table, No. 3). Now, these diagonals in the aisle are round arched (Fig. 1a), and in the nave nearly

[1] Of the later destruction, we have unfortunately no illustrations. No post cards of the interior were published as late as May, 1919, and it was forbidden to enter when I was there in October, 1918, on account of falling stones.

so (Fig. 5), to while all the other ribs are pointed (Figs. 4, 5). Apparently then, as far as construction went, the advantages were with the round arch, and the pointed was adopted for other reasons, such as reducing the thrust and the possibility of coördinating the arches and vaults, or beauty of form, or both. But the evidence of the ruins is by no means final in determining which was the stronger form of arch. It should be considered rather as one of a series of facts which further knowledge of the construction and of its history may some day establish.

One of the other interesting developments in the style is the change of the pinnacle on the buttress from a purely useful to an almost purely decorative purpose. In the chevet of Rheims (Fig. 14) there are two of the lofty pinnacle canopies destroyed and a third which lacks one of its columnar supports. All this has happened without much surrounding damage except to a light parapet, thus giving evidence of the real lightness of these constructions in spite of their solid appearance. Although this is hardly proof, for one could hardly expect the loss of even so high a pinnacle to cause the collapse of its buttress, yet it is a strong indication that this feature as early as the date of Rheims was known to be unessential to stability, and was actually, as it was in appearance, a decorative feature.

One more observation, and that of a general character, remains to be made. Among our first impressions, after studying the later illustrations of Soissons (Fig. 2), was the importance of the structure that remained when the vault had fallen. This came as a distinct surprise in view of the lengthy studies of the vaulting and its supports with which our works on Gothic are filled. One rather expected to find that the exterior wall which enclosed the vault-conoid was but an incident of the latter and would fall with it, that the church consisted of nothing but vaults, piers, and buttresses, and the enclosing "walls of stained glass." But here the observer counts the vaults of four out of the seven nave bays gone—two of them literally sloughed away—and yet the greater part of the structure is still erect. He sees the walls standing with all the composition of the nave complete, except for the timber roof instead of the vaults (Fig. 18), and he remembers with dismay the abhorred fallacies of Fergusson[1] about the "deceptive stone ceilings." He realizes, too, that this was the way the building looked in the middle ages during the

[1] Fergusson, *History of Architecture*, I, p. 321.

long years when it was under construction, though more or less used for worship, until the final stage, when the vault was built in,—under the protection of the roof. He recalls moreover that to the mediaeval designer of the building that roof and those walls, the weight of the triforium, the aisle roof and its supports, the wind-bracing, and the disposal of floods of water and snow, all were a part of his problem,—and that he solved them all without, or in spite of, his vaults. And so he comes away at the last with a new sense of the building as a whole, con-

FIGURE 18.—INTERIOR OF THE ROOF: SOISSONS.

ditioned it is true in its fundamentals by the vault, but a great construction and a great design in and of itself.

In closing this survey of these two great examples of the theory of Gothic, what summary can we make? In the first place we see that the theory is truest, as it is most generally agreed upon, in its insistence on the organization of the structure, and that this is indeed wonderfully shown in the way it acted under the stress of bombardment.

In the next place, while the ruins reveal that the vaulting follows closely the necessities of construction, they reveal other

portions and other relations of parts which are contrary to them. These cases are not indeed the most important, but they are sufficient to refute the theory that constructional requirements carried to their logical conclusion can alone account for these designs. They are due to esthetic reasons almost entirely, and they indicate the probable importance of those reasons throughout.

The principle of balanced thrusts is far less true, and it should apparently have a minor place. It seems clearly at variance with the facts in its principal example of the flying arch and it seems to apply only to certain of the vault ribs.

The apparent revelation of structure seems to be over emphasized, to judge from these ruins, especially in certain cases such as the pier shafts, flying arch, and some features of the vault, often quoted as proving it. It should be considered, as I believe it must have been by the mediaeval builders themselves, as an architectural resource rather than a principle; to be freely enlarged upon, compromised, or denied, when the esthetic effect of the whole seemed to require it.

The lightness of the construction is strikingly confirmed, but it appears rather as a matter of necessity in the actual construction, and a matter of architectural design in the exposed portions.

In all that has been said so far, we have limited ourselves to the theory; when we have found the facts at variance with it we have emphasized not what the architecture *was*, but what it was *not*. Thus we seem to have stripped it of one quality after another. We have apparently been destructive, seizing upon its terrible misfortunes to prove it somehow wrong.

Let us now turn the page. What seems destructive is in reality freeing these beautiful creations from the too rigid shackles of classification devised by scientifically-minded men of letters. Sweeping assertions built upon the enthusiastic hypotheses of Viollet-le-Duc or on literary theories of architecture do only harm to an art such as this, and cause revulsion instead of devotion among its admirers. A looser, freer, truer theory is the only one that will fit such a history of the human spirit as is built into these cathedrals. If in so doing we are to deprive the historian of his "most satisfactory" chapter, where "all rests on undeniable mathematical and scientific premises,"[1] so much the worse for him. Of all great architecture, this is the most imaginative, the

[1] Sturgis and Frothingham, III, p. 9.

most founded on a purely ideal program. While developed with wonderful reasoning, that immaterial program,—namely religious sentiment, with its accompanying feeling for height and mystery, —is at the base of it all and is felt throughout.

In thus breaking sharply with certain points of the writers' theories, we are in no way taking a step backward, but rather looking toward the future. These ruins seem inevitably to suggest another statement of Gothic, not a part of this present paper, as it may come to be written with our changing point of view, a statement in which the ribs of the vaults, the shafts of the piers, the actual shape of the flying arches, the all-including openings, and finally the façade, will find their true explanation as parts of a purely architectural design, absorbing, yet dominating the requirements of prelate and mason alike.

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ADDITIONAL NOTE ON PP. 49–51

The following quotation from *Guides Illustrés Michelin des Champs de Bataille* (Paris, 1919), section on Soissons, p. 21, shows how the ruin at Soissons, discussed on pp. 49–51, was caused.

"At the beginning of February, 1915, a shell . . . struck the second column of the nave and cut into it at 4 m. above the ground. The portion above with the capital and the stone courses carrying the load of the vault ribs collapsed, dragging down in its fall a section of the triforium and back wall. This ruin was soon increased. At the end of March the vaults of the nave and aisle, formerly held by the broken column, no longer having their support, fell; the whole (section) of the triforium, the window, the exterior flying arch, the wood framing, and the roof of the nave bay crashed down also."

This, if correct,—and there is no reason why so circumstantial an account should not be believed,—although it overthrows my surmise as to how the break occurred (pp. 50 f.), confirms the general position of this paper, that there was less balance of thrusts and less revelation of structure than usually supposed.